EQDP-ESE-48
Rev. 0, 1/83

EQUIPMENT QUALIFICATION DATA PACKAGE

This document contains information, relative to the qualification of the equipment identified below in accordance with the methodology of WCAP-8587. The Specification section (Part 1) defines the assumed limits for the equipment qualification and constitute interface requirements to the user.

High Volume Sensor: Qualification Group A

APPPOVED: _____
for E. P. Rahe, Manager
Nuclear Safety Department

WESTINGHOUSE ELECTRIC CORPORATION
NUCLEAR ENERGY SYSTEMS
PITTSBURGH, PENNSYLVANIA 15230

SECTION 1 - SPECIFICATIONS

1.0 PERFORMANCE SPECIFICATIONS

1.1 Electrical Requirements

1.1.1 Voltage: N/A

1.1.2 Frequency: N/A

1.1.3 Load: N/A

1.1.4 Electromagnetic Interference: None

1.1.5 Other: None

1.2 Installation Requirements: Wall mounted per Westinghouse Drawing 9557D89 Rev. 4

1.3 Auxiliary Devices: None

1.4 Preventative Maintenance Schedule: None; inspection and cleaning of sensor in accordance with instruction manual when sensor housing is removed.

1.5 Design Life: 40 years

1.6 Operating Cycles (Expected number of cycles during design life, including test): Continuous duty.

1.7 Performance Requirements for Function: Reactor Vessel Level Instrumentation Sensor

	Parameter	Normal Conditions	Abnormal Conditions	Containment Test Conditions	DBE Conditions[a] FLB/SLB	DBE Conditions[a] LOCA	DBE Conditions[a] Seismic	Post DBE Conditions[a] FLB/SLB	Post DBE Conditions[a] LOCA	Post DBE Conditions[a] Seismic
1.7.1	Time requirement	Continuous	Included under normal	Test Duration	<5 Min.	Event Duration	Event Duration	4 months	4 months	Continuous
1.7.2	Performance (c) requirement (d)	(e)		No damage	(e)	(e)	(e)	(e)	(e)	(e)

1.8 Environmental Conditions for Same Function[b]

1.8.1	Temperature (°F)	50 - 122	Included under normal	Ambient	Figure 2	Figure 3	Ambient	Figure 2	Figure 3	Ambient
1.8.2	Pressure (psig)	-0.1/+0.3		70	Figure 2	Figure 3	0	Figure 2	Figure 3	0
1.8.3	Humidity (% RH)	0 - 95		Ambient	100	100	Ambient	100	100	Ambient
1.8.4	Radiation (R)	$< 10^4$		None	Included Under Post DBE	Included Under Post DBE	None	3.9×10^4 γ 6.4×10^5 β	4.1×10^7 γ 9×10^8 β	None
1.8.5	Chemicals	None		None	Figure 2	Figure 3	None	Figure 2	Figure 3	None
1.8.6	Vibration	None		None	None	None	None	None	None	None
1.8.7	Acceleration (g)	None		None	None	None	Figure 1	None	None	None

Notes:
(a) DBE is the Design Basis Event.
(b) Margin is not included in the parameters of this section.
(c) Reference accuracy specified. Values shown for accuracy under DBE and Post DBE conditions include ± 1% for normal conditions which is not part of the DBE induced effects.
(d) Time Response
(e) No contribution to transmitter reference accuracy

1.9 Qualified Life: The currently demonstrated qualified life is 10 years based on an average ambient temperature of 50°C (122°F). (See Table 1)

1.10 Remarks: None

EQUIPMENT QUALIFICATION DATA (PART 2 - QUALIFICATION BY TEST)

2.0 TEST PLAN

The thermal aging and mechanical cycling tests were performed at Westinghouse Forest Hills Site in Pittsburgh, Pennsylvania. The gamma irradiation of the sensor was performed at Radiation Technology in Rockaway, New Jersey. Design basis event seismic simulation was performed at Westinghouse Advanced Energy Systems Division (AESD), in Large Pennsylvania. The High Energy Line Break simulation was performed at the Westinghouse Forest Hills Site in Pittsburgh, Pennsylvania.

2.1 Equipment Description: ITT Barton - High Volume Sensor Model 353

2.2 Number Tested: 3 Barton units

2.3 Mounting: Per Westinghouse Drawing 9557D89, Rev. 4

2.4 Connections: (a) Process connections, capillary tube

2.5 Aging Simulation Procedure:

Sequential simulation of thermal, radiation and vibrational mechanisms as part of the overall test sequence.

2.6 Simulated Service Conditions[1]: See Section 2.11 for notes.

		Normal/ Abnormal	Thermal Aging/ Mechanical Cycling	Radiation	Cont. Test	Seismic	HELB/ Post-HELB
2.6.1	Temp (°F)	40 - 120°F	104°F (10 years)	Ambient	Covered by HELB	Ambient	Figure 4
2.6.2	Pressure (psig)	Atmos.	Atmos.	Atmos.		Atmos.	Figure 4
2.6.3	Humidity (% RH)	0 - 95	Ambient	Ambient		Ambient	100
2.6.4	Radiation (R)	None	None	$5 \times 10^7 \gamma$ $9 \times 10^8 \beta$		None	Included under radiation
2.6.5	Chemicals	None	None	None		None	Figure 4
2.6.6	Vibration	None	None	None		5 OBE's	None
2.6.7	Acceleration (g)	None	None			TRS>RRS Figure 1	None
2.6.8	Process Cycling	None	10^6	None		None	None

2.7 Measured Variables

		Required	Not Required
2.7.1	Category I - Environment		
2.7.1.1	Temperature	A,B,C,D,E	
2.7.1.2	Pressure	E	A,B,C,D
2.7.1.3	Moisture	A,E	B,C,D
2.7.1.4	Gas Composition		A,B,C,D,E
2.7.1.5	Vibration	D	A,B,C,E
2.7.1.6	Time	A,B,C,D,E	
2.7.2	Category II - Input Electrical Characteristics		
2.7.2.1	Voltage		A,B,C,D,E
2.7.2.2	Current		A,B,C,D,E
2.7.2.3	Frequency		A,B,C,D,E
2.7.2.4	Power		A,B,C,D,E
2.7.2.5	Other		A,B,C,D,E
2.7.3	Category III - Fluid Characteristics		
2.7.3.1	Chemical Composition	E	A,B,C,D
2.7.3.2	Flow Rate	E	A,B,C,D
2.7.3.3	Spray	E	A,B,C,D
2.7.3.4	Temperature		A,B,C,D,E
2.7.4	Category IV - Radiological Features		
2.7.4.1	Energy Type	C	A,B,D,E
2.7.4.2	Energy Level	C	A,B,D,E
2.7.4.3	Dose Rate	C	A,B,D,E
2.7.4.4	Integrated Dose	C	A,B,D,E

		Required	Not Required
2.7.5	Category V - Electrical Characteristics		
2.7.5.1	Insulation Resistance		A,B,C,D,E
2.7.5.2	Output Voltage		A,B,C,D,E
2.7.5.3	Output Current		A,B,C,D,E
2.7.5.4	Output Power		A,B,C,D,E
2.7.5.5	Response Time		A,B,C,D,E
2.7.5.6	Frequency Characteristics		A,B,C,D,E
2.7.5.7	Simulated Load		A,B,C,D,E
2.7.6	Category VI - Mechanical Characteristics		
2.7.6.1	Thrust		A,B,C,D,E
2.7.6.2	Torque		A,B,C,D,E
2.7.6.3	Time		A,B,C,D,E
2.7.6.4	Load Profile		A,B,C,D,E
2.7.7	Category VII - Auxiliary Equipment		
	None		

A: Normal/Abnormal (Type Test)
B: Thermal Aging/Mechanical Cycling
C: Radiation
D: Seismic
E: HELB/Post-HELB

2.8 Test Sequence Preferred

This section identifies the preferred test sequence as specified in IEEE-323-74.

2.8.1 Inspection of Test Item
2.8.2 Operation (Normal Condition)
2.8.3 Operation (Performance Specification Extremes, Section 1)
2.8.4 Simulated Aging
2.8.5 Vibration
2.8.6 Operation (Simulated High Energy Line Break Conditions)
2.8.7 Operation (Simulated Post HELB Conditions)
2.8.8 Inspection

2.9 Test Sequence Actual

This section identifies the actual test sequence to which the High Volume Pressure Sensors were subjected. Sections 2.8.2 and 2.8.3, operation at normal conditions and at performance specification extremes are covered by operation throughout the sequence, including under the more severe HELB conditions. High energy line break and post-HELB radiation doses are included with normal dose in testing and are not combined with temperature/ humidity conditions.

2.9.1 Test Sequence Actual

2.8.1 Inspection
2.8.2 Operation - Normal Conditions
2.8.3 Operation - Performance Specification Extremes
2.8.4 Mechanical Cycling/Electrical Cycling/Accelerated Thermal Aging
2.8.4 Radiation - Normal 10 Year Dose
2.8.5 Radiation HELB/Post HELB Dose
2.8.6 Seismic Simulation/Vibration
2.8.7 Operation (Simulated High Energy Line Break Conditions)
2.8.8 Operation (Simulated Post-HELB Conditions)
2.8.9 Operation (Including time response)
2.8.10 Inspection if Required

2.10 Type Test Data

2.10.1 Objective

The objective of this test program is to demonstrate, employing the recommended practices of Reg. Guide 1.89 (IEEE 323-1974) and Reg. Guide 1.100 (IEEE 344-1975), the capability of the high volume sensors to perform their safety related functions described in EQDP 1.7 while exposed to the environments defined in EDQP Section 1.8.

2.10.2 Equipment Tested

2.10.2.1 Test Units

Three (3) ITT Barton Model 353 High Volume Sensors were subjected to the test environments of the sequence shown in Section 2.9.1.

2.10.3 Test Summary

2.10.3.1 Test Summary

2.10.3.1.1 Normal Environment Testing

Operation of the high volume sensors under normal/abnormal environment conditions is demonstrated by operation throughout the test sequence, including at more severe DBE conditions.

2.10.3.1.2 Simulated Aging

The units were pre-conditioned to a simulated ten year aged condition prior to subjecting them to the design basis seismic event and high

energy line break simulations. The aged condition was achieved by separate phases of mechanical cycling, accelerated thermal aging and gamma radiation dose equivalent to the ten year normal gamma dose plus the design basis accident gamma dose plus the gamma equivalent beta dose. Throughout the pre-conditioning phases the sensors by way of a differential pressure indicating switch, were monitored and recorded.

2.10.3.1.3 Seismic Tests

The seismic testing employed multi-axis multi-frequency inputs in accordance with Reg. Guide 1.100 (IEEE-344-1975). The generic required response spectra (RRS) shown in Figure 1 contains significant margin with respect to any single plant application referencing this program(1). Each plant should compare to the applicable RRS (A, B, or C) to assure that a 10 percent margin exists based on their actual plant location.

2.10.3.1.4 High Energy Line Break/Post HELB Simulation

The high volume sensors were subjected to the HELB simulation profile of Figure 4. Following the 340°F temperature peak, the temperature gradually declines to 225°F and is held at saturated steam conditions for 12 days, simulating a four month period of post-HELB operation.

2.10.4 Conclusion

The qualification status of Qualification Group A High Volume Sensors is demonstrated by the completion of the simulated aging and design basis event condition testing described herein and reported in Reference 1.

2.11 Section 2 Notes

(1) The generic tests completed by Westinghouse employ parameters designed to envelope a number of plant applications. Margin is a plant specific parameter and will be established by the applicant.

2.12 References

1. Skeers, D. M., Black, J. P., Rygg, D. E., "Equipment Qualification Test Report High Volume Sensor - Qualification Group A (Sesimic and Environmental Testing)" WCAP-8687-Supp. 2-E48A (Proprietary).

SECTION 3 AND 4 QUALIFICATION BY EXPERIENCE AND/OR ANALYSIS

Westinghouse does not employ operating experience or analysis in support of the qualification program for the High Volume Sensor - Qualification Group A.

TABLE 1

ACTUAL QUALIFICATION TEST CONDITIONS

EQUIPMENT (1) SYSTEM/CATEGORY	LOCATION STRUCTURE/AREA	MANUFACTURER TYPE/MODEL	ABNORMAL/ACCIDENT ENVIRONMENTAL EXTREMES PARAMETER	SPECIFIED (2)	QUALIFIED	OPERABILITY REQ	OPERABILITY DEM	ACCURACY( ) REQ	ACCURACY( ) DEM	QUAL LIFE(3)	QUAL METHOD	QUAL REF	QUAL PROGRAM STATUS
RVLIS sensor/ Category a	Containment Bldg./outside missile shield	Barton 353	Temperature		420°F	Post	Same		Same	10 yrs.	Seq. Test	ESE-48	Completed
			Pressure		57 psig	DBE							
			Rel. humidity		100%	4 Mo.							
			Radiation		5×10^7 R(γ)								
					9×10^8 R(β)								
			Chemistry		2500 ppm H_3BO_3								
					NaOH								
					10.7 pH								

Notes: (1) For definition of the equipment category, refer to NUREG-0588 "Interim Staff Position on Environmental Qualification of Safety-Related Equipment Electrical Equipment," Appendix E Section 2.

(2) Plant specific environmental parameters are to be inserted by the applicant.

(3) Qualified life is based on a service condition of 104°F (40°C).

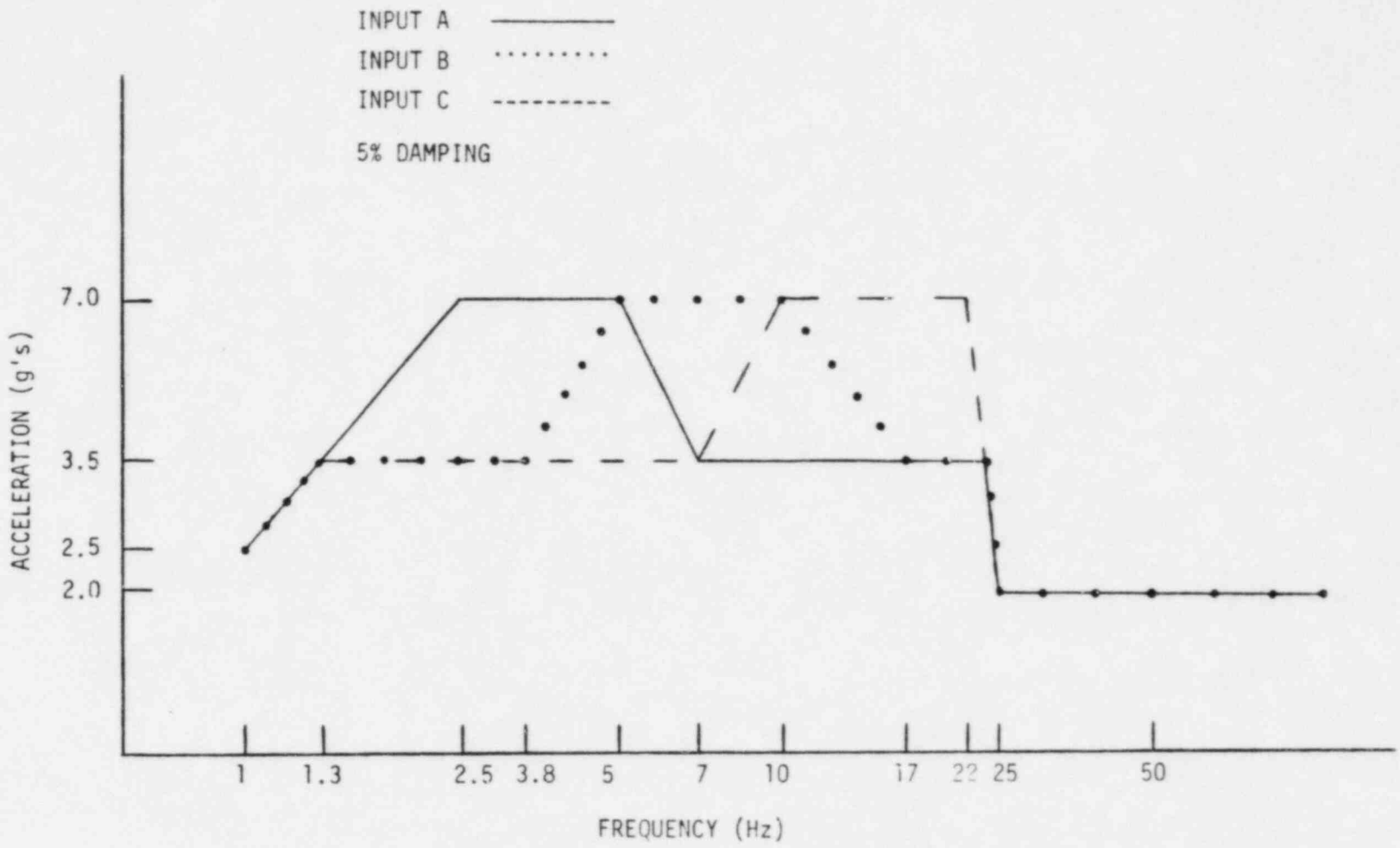
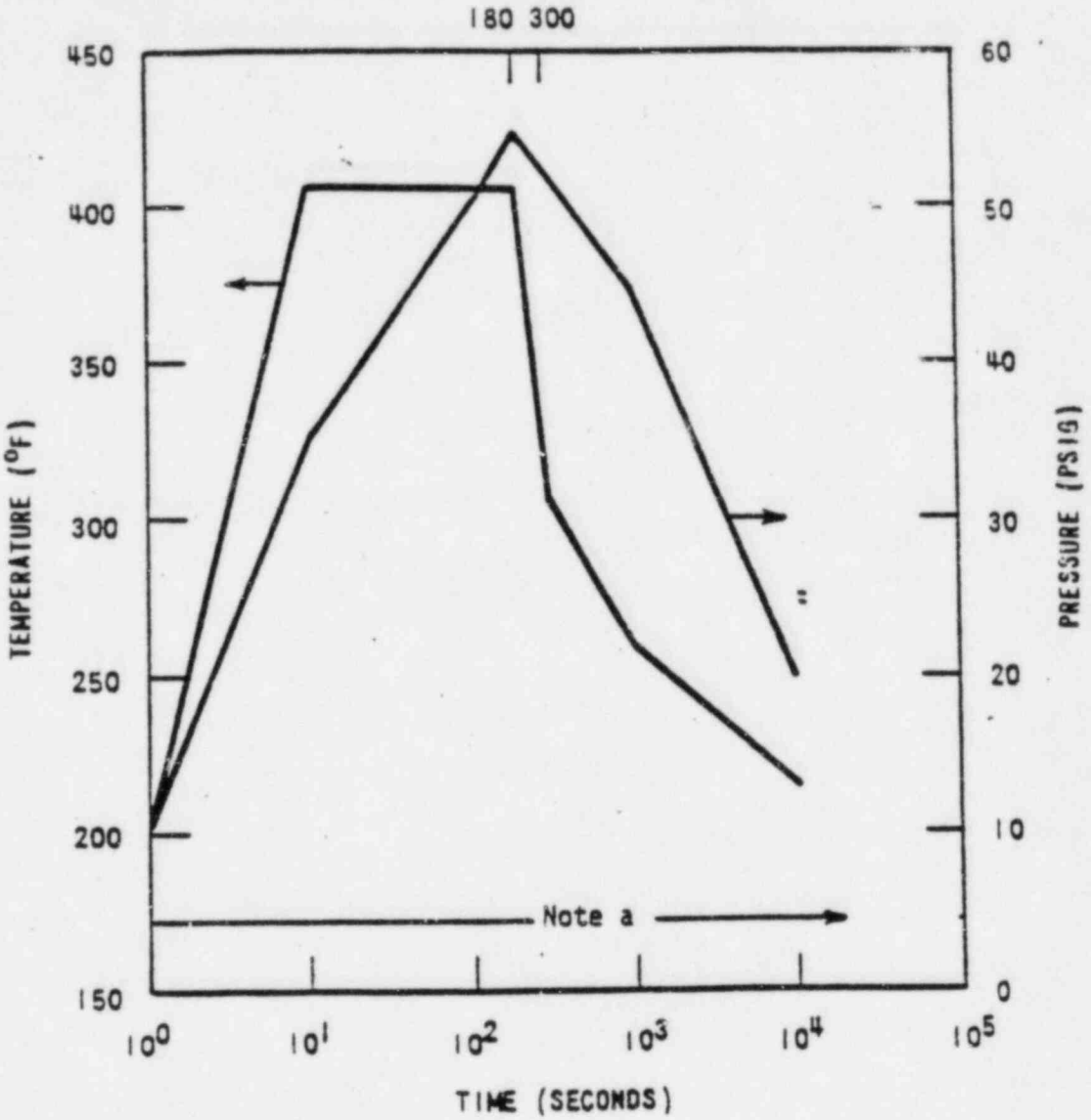


FIGURE 1

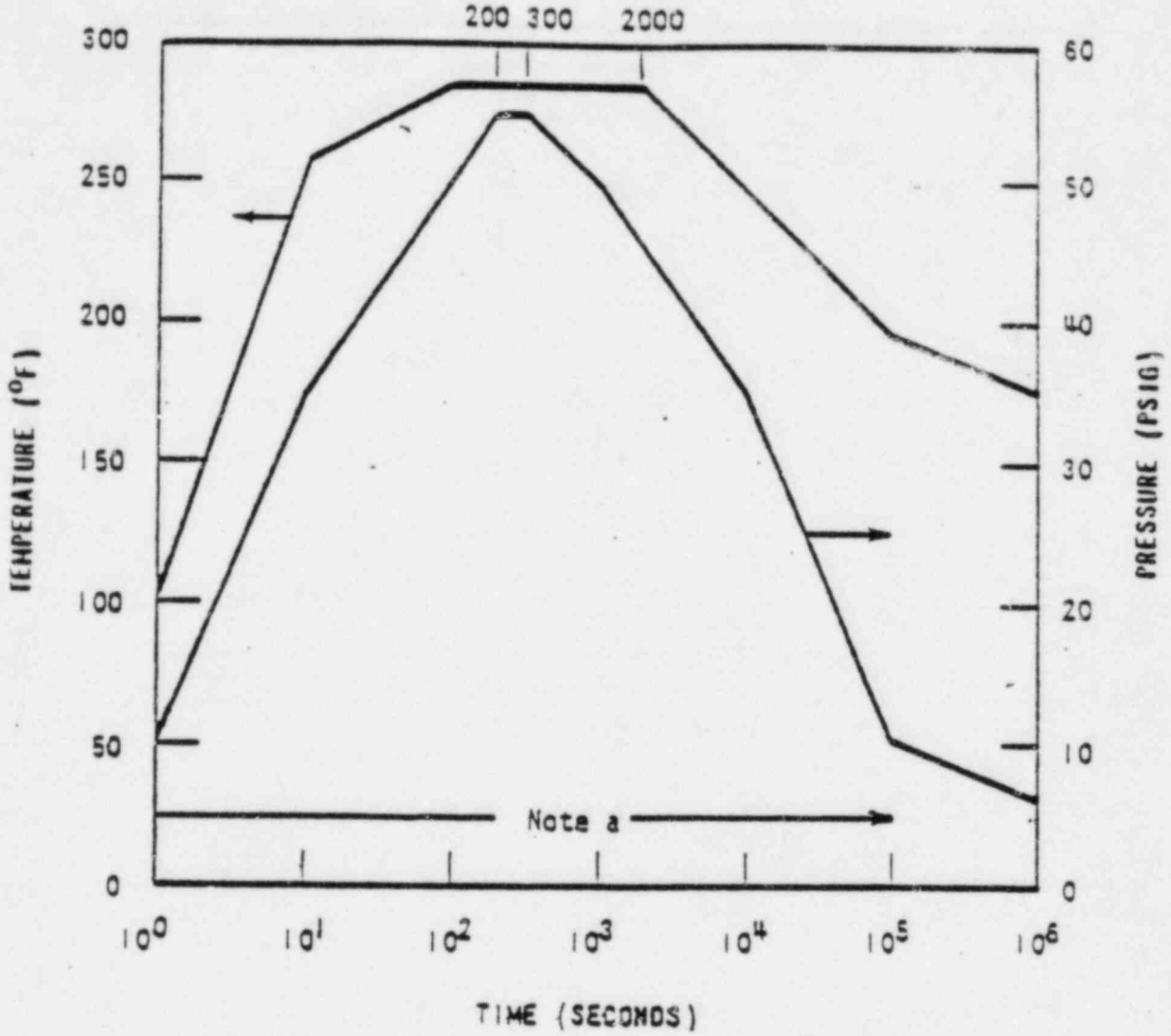
REQUIRED RESPONSE SPECTRA FOR SAFE SHUTDOWN EARTHQUAKE (SSE) HIGH VOLUME SENSOR SEISMIC QUALIFICATION ALONG EQUIPMENT PRINCIPLE AXES

(NOTE: OPERATING BASIS EARTHQUAKE (OBE) REQUIRED RESPONSE SPECTRUM = 0.5 SSE OF INPUT B)



Note a: Initial 24 hour containment spray solution of 2500 PPM Boron in water buffered with NaOH to yield a pH of 10.7

Figure 2. Containment Environmental Design Conditions Main Steam Line Break and Feedline Break



Note a: Initial 24 hour containment spray solution of 2500 PPM Boron in water buffered with NaOH to yield a pH of 10.7

Figure 3. Containment Environmental Design Conditions - LOCA

SLB/FLB/LOCA PROFILE

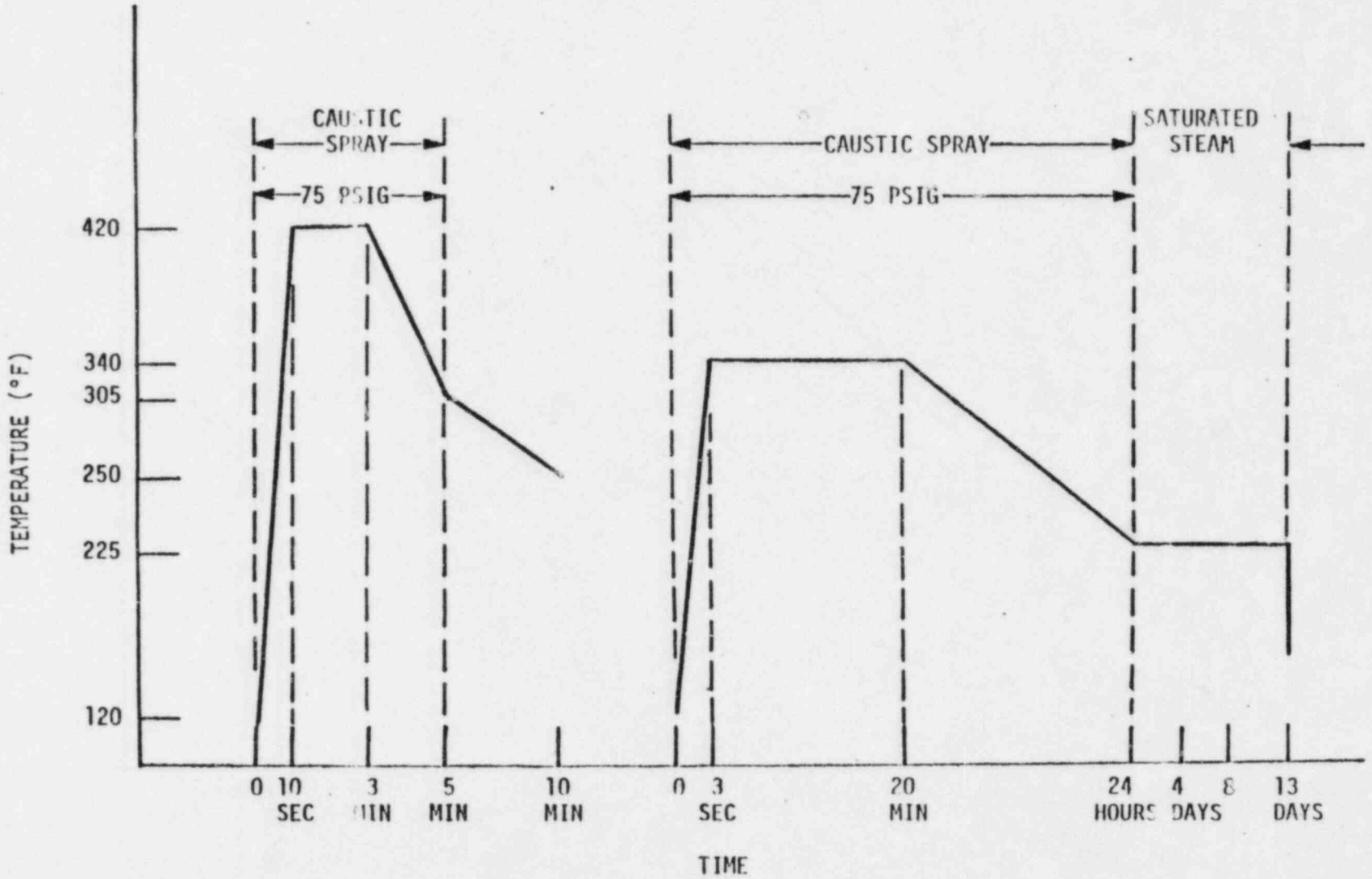


Figure 4